NASA Advisory Council
National Aeronautics and Space Administration
Washington, DC 20546
Dr. Kenneth M. Ford, Chairman

May 18, 2009

Mr. Christopher J. Scolese
Acting Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Mr. Scolese:

Enclosed are the NASA Advisory Council (NAC) recommendations as agreed to in a public meeting on April 16, 2009, held at NASA Headquarters, Washington, DC. We were able to leverage the benefits of this meeting location with the Space Operations Committee taking a tour of Orbital Sciences Corporation in nearby Virginia.

The Council had very productive meetings culminating in the Council making eight recommendations that we believe will be of assistance as NASA continues its implementation of its space exploration mission. The Council will continue to monitor and consider future recommendations that may be of assistance to you.

Human Capital Committee Recommendations

1. **Addressing the need to infuse new talent and knowledge into the NASA workforce:** Continued leadership in space science and exploration requires the constant infusion of new ideas and state-of-the-art knowledge provided by a vibrant and creative workforce. Therefore, NASA is encouraged to pursue avenues that will facilitate new hiring, particularly at the entry-level.

2. **Assessment of how NASA TV can be more effective and what is required to accomplish that goal:** NASA is encouraged to provide resources to an outside organization to conduct an agency-wide evaluation of the current content, effectiveness, and viewership of NASA TV and to recommend a clear plan for its most effective utilization. This outside entity should take into account the NASA internal 2007 review of NASA TV as well as new web based initiatives. The outcome of this study should include recommendations for the level and type of resources required to most effectively engage the public and disseminate NASA content.

Space Operation Committee Recommendations

3. **Teaching and Applying Lessons Learned to NASA's Human Spaceflight Employees:** To effectively transfer hard-won "lessons learned" to its human spaceflight work force, NASA is encouraged to institute recurring training for the

workforce using a curriculum based on existing Safety and Mission Assurance materials. The training program should include lessons learned from the Apollo, Skylab, Mir, Shuttle, and ISS accidents, incidents, and close calls. Additionally, NASA's human spaceflight organizations (e.g. Constellation, Shuttle, ISS) should incorporate the safety lessons and practices learned from conception to operation into their programs. Such institutions should document training programs and take full advantage of learning tools derived from the Apollo 1, Challenger, and Columbia accidents.

4. **Documentation and Teaching of Human Spaceflight Lessons Learned:** A portion of the NASA training program should focus on lessons learned from the human spaceflight missions in order to retain historical knowledge, as many older employees will be retiring. NASA should document specific major operational lessons learned from human spaceflight programs. These lessons learned should be written / presented in a format to facilitate ease of training for the next generation of space workers.

5. **NASA Cost-Benefit Study of Possible Active Methods for Orbital Debris Removal:** NASA is encouraged to conduct an in-house study of the current and projected orbital debris situation in order to evaluate the costs and benefits of developing a form of debris removal technology. The study should compare the costs of operating in the ever-expanding debris population with those of developing a selective debris removal method, and how those compare with long-term savings from actively reducing the threat of future collisions. We also recommend that the NASA study identify to the USAF possible enhancements to the nation's debris detection, tracking, and prediction capabilities that will improve spacecraft protection.

Science Committee Recommendations

6. **Form an Exoplanet Exploration Program Analysis Group under the Astrophysics Subcommittee:** NASA is encouraged to form an Exoplanet Exploration Program Analysis Group (ExoPAG) to conduct analyses at the request of the NAC Science Committee, the Astrophysics Subcommittee, and SMD. The ExoPAG will take direction from APS, and report to APS.

7. **Process for identifying non-science requirements and funding for Earth observations:** NASA is encouraged to work with OSTP and other agencies at the highest levels to define responsibilities and secure funding for Earth observations beyond those recommended by the NRC Decadal Survey to advance Earth System Science.

Exploration, Science, and Space Operations Committees Recommendation

8. **Independent study of space communications - requirements, capabilities, and architecture:** NASA is encouraged to contract for an independent study of space communications needs for science, exploration, and space operations. The report resulting from this study should include findings and recommendations that will assist NASA in planning a communications architecture that will enable the successful

conduct of missions planned or conceivable through 2030. This study should result in recommendations that will assist NASA in development of more detailed, quantifiable requirements.

If there are any questions on the proceedings of our meeting, please contact me.

Best regards,

Ken Ford

Kenneth M. Ford
Chairman

Enclosures

NASA Advisory Council
Council Recommendation

Tracking Number: HCC-09-01

Committee name: Human Capital Committee

Chair: Dr. Gerald Kulcinski

Date of public deliberation: April 16, 2009

Date of transmission: May 13, 2009

Short Title of the Recommendation

Addressing the need to infuse new talent and knowledge into the NASA workforce

Short description of the Recommendation

Continued leadership in space science and exploration requires the constant infusion of new ideas and state-of-the-art knowledge provided by a vibrant and creative workforce. Therefore, NASA is encouraged to pursue avenues that will facilitate new hiring, particularly at the entry-level.

Major reasons for the Recommendation

NASA's current workforce consists primarily of mid-level and senior-level professional Scientists and Engineers. Given the Constellation program, there is a need to ensure that the NASA workforce continues to have the skills and knowledge to support advanced, state-of-the-art technology. Therefore, NASA needs to focus on hiring "fresh-out" talent, which is defined as individuals who have obtained a degree within the past three years. Injecting the workforce with new ideas and newly-developed technological knowledge will ensure that NASA had the talent needed to support current and future aeronautics missions.

Consequences of no action on the Recommendation

A constant infusion of new ideas is needed for Constellation and the other NASA programs, to assure the continued mix of state-of-the art and tried and true solutions that led to NASA's many successes over the past 50 years. This mix is best accomplished by hiring recent graduates, or those who have returned for advanced degrees recently. These sources may also provide opportunities for continued enhancement of diversity and inclusiveness in the NASA workforce. Failure to provide a broad range of expertise and talent across the workforce spectrum could lead to stagnation in the workforce and make it more difficult to accomplish NASA's multiple missions or compete effectively with other space faring nations in the exploration of the Solar System.

NASA Advisory Council
Council Recommendation
Tracking Number: HCC-09-02

Committee name: Human Capital Committee

Chair: Dr. Gerald Kulcinski

Date of public deliberation: April 16, 2009

Date of transmission: April 29, 2009

Short title of the Recommendation

Assessment of how NASA TV can be more effective and what is required to accomplish that goal

Short description of the Recommendation

Resources be provided to an outside organization to conduct an agency-wide evaluation of the current content, effectiveness, and viewership of NASA TV and to recommend a clear plan for its most effective utilization.

This outside entity should take into account the NASA internal 2007 review of NASA TV as well as new web based initiatives.

The outcome of this study should include recommendations for the level and type of resources required to most effectively engage the public and disseminate NASA content.

Major reasons for the Recommendation

The Committee's fact-finding sessions have determined that NASA TV is underfunded and has not been upgraded on an Agency-wide basis with new technology such as On-Demand and High Definition TV.

NASA TV was initiated, in part, to support the Shuttle Program. Now that Shuttle retirement is now planned for 2010, it is reasonable to reassess this important communication vehicle to ensure that NASA TV continues to be a valuable asset to the American public. Additionally, new technology, particularly the emergence of internet based delivery, further supports the need to examine the NASA TV to ensure that it encompasses the state-of-the-art technology required to remain a viable communication resource. Therefore, it is imperative that NASA seek an external source to complete a comprehensive study to evaluate the current content, effectiveness and viewership of NASA TV and to recommend a clear plan and set of themes to ensure its most effective utilization.

Consequences of no action on the Recommendation

At this point in time, a number of fiscal decisions are being made that may impact NASA-TV. An external study will inform the NASA Administrator and the Chief, Strategic Communications Office of the effectiveness of the current program, provide a picture of the average demographics of NASA TV viewer, and provide direction on how to accurately target resources to maintain state-of-the-art technology. If the recommendation to conduct an external study is not heeded by NASA leadership, the result could be that NASA TV, due to lack of resources, dwindling viewership, and lack of state-of-the-art technology, could become defunct.

NASA Advisory Council
Committee Recommendation

Tracking Number: SO-09-01

Committee Name: Space Operations

Chair: Col. Eileen Collins (Ret.)

Date of Public Deliberation: February 6, 2009

Date of Transmission: February 17, 2009

Short title of the Recommendation

Teaching and Applying Lessons Learned to NASA's Human Spaceflight Employees

Short description of the Recommendation

To effectively transfer hard-won "lessons learned" to its human spaceflight work force, NASA should institute recurring training for them using a curriculum based on existing Safety and Mission Assurance materials. The training program should include lessons learned from the Apollo, Skylab, Mir, Shuttle, and ISS accidents, incidents, and close calls.

NASA's human spaceflight organizations (e.g. Constellation, Shuttle, ISS) should incorporate the safety lessons and practices learned from conception to operation into their programs. Such institutions should document training programs and take full advantage of learning tools derived from the Apollo 1, Challenger, and Columbia accidents.

Having completed training, program and project management need to verify that new system designs comply with the lessons learned database.

Major Reasons for Proposing the Recommendation

NASA's Safety & Mission Assurance organization has an effective employee curriculum for transferring lessons learned, but NASA is missing an opportunity to teach those principles to all human spaceflight team members. The shuttle transition process and associated future work force turn-over may result in the loss of vital, hard-won knowledge and experience. Recurring training is especially important to preserve a healthy safety culture.

Although Orion operations will differ from shuttle, many generic lessons from the shuttle and earlier programs can improve safety awareness and prevent potential accidents. Regular exposure to NASA's failures and the lessons drawn from them will better prepare both veterans and new employees to operate Constellation systems safely.

Consequences of no action on the recommendation

Failure to expose the next generation of NASA's human spaceflight workers to hard-won lessons learned will expose future programs to unnecessary and avoidable risk. Future programs may repeat past mistakes.

NASA Advisory Council
Committee Recommendation

Tracking Number: SO-09-02

Committee Name: Space Operations

Chair: Col. Eileen Collins (Ret.)

Date of Public Deliberation: February 6, 2009

Date of Transmission: February 17, 2009

Short title of the Recommendation

Documentation and Teaching of Human Spaceflight Lessons Learned

Short description of the Recommendation

A portion of the NASA training program should focus on lessons learned from the human spaceflight missions in order to retain historical knowledge, as many older employees will be retiring. NASA should document specific major operational lessons learned from human spaceflight programs. These lessons learned should be written / presented in a format to facilitate ease of training for the next generation of space workers.

Major Reasons for Proposing the Recommendation

Concerns exist where the labor force may turn over in sufficient quantity to permit loss of knowledge and experience. Although the Orion missions will differ from the shuttle missions, there are many generic lessons from which new employees can learn. By documenting certain incidents which are good case studies, both new employees and veterans can be better prepared to operate the Orion launch and flight system. Some examples could be: Gemini-Titan 8, Skylab Rescue Capability, Mir-Progress collision, STS-49 Intelsat retrieve, STS-47 tethered satellite loss, STS-80 jammed EVA hatch, STS-51A Palapa / Westar retrieval, STS-87 Spartan mission loss, STS-83 fuel cell anomaly, STS-93 electrical short and LOX low level cut-off, etc. These lessons should also include major ground processing, launch countdown and personnel incidents.

Consequences of no action on the recommendation

Insufficient documentation and training for the next generation of space workers may result in repeating generic problems.

NASA Advisory Council
Committee Recommendation
Tracking Number: SO-09-03

Committee Name: Space Operations

Chair: Col. Eileen Collins (Ret.)

Date of Public Deliberation: April 16, 2009

Date of Transmission: April 23, 2009

Short title of the proposed Recommendation

NASA Cost-Benefit Study of Possible Active Methods for Orbital Debris Removal

Short description of proposed Recommendation

We recommend that NASA conduct an in-house study of the current and projected orbital debris situation in order to evaluate the costs and benefits of developing a form of debris removal technology. The study should compare the costs of operating in the ever-expanding debris population with those of developing a selective debris removal method, and how those compare with long-term savings from actively reducing the threat of future collisions. We also recommend that the NASA study identify to the USAF possible enhancements to the nation's debris detection, tracking, and prediction capabilities that will improve spacecraft protection.

Major reasons for proposing the Recommendation

The growing debris population, expanded significantly by recent ASAT tests and random collisions, poses a continuing and increasing threat to operational spacecraft. Despite international protocols on preventing the creation of future debris, the debris population will continue to expand for decades, well past the middle of the century. Recognizing that the Department of Defense has primary responsibility for the tracking mission, some gaps exist in U.S. detection capabilities, especially at smaller debris sizes that can still cause catastrophic damage to spacecraft. The projected debris population will, over decades, result in additional damage to or loss of spacecraft, and poses a growing threat to spacecraft. NASA may be able to offer methods to actively reduce the debris population. The benefits of reducing the debris population will accrue to commercial, military, and NASA spacecraft.

Consequences of no action on the proposed Recommendation

The orbital debris population will continue to grow with no prospect for significant mitigation or reduction, posing an increasing danger to both human and robotic spacecraft operations, even as we become more dependent on our constellation of space assets.

NASA Advisory Council
Council Recommendation

Tracking Number: SC-09-03

Committee name: Science Committee

Chair: Dr. Jack Burns

Date of public deliberation: April 16, 2009

Date of transmission: April 29, 2009

Short title of the proposed Recommendation

Form an Exoplanet Exploration Program Analysis Group under the Astrophysics Subcommittee.

Short description of proposed Recommendation

Recommend NASA form an Exoplanet Exploration Program Analysis Group (ExoPAG) to conduct analyses at the request of the NAC Science Committee, the Astrophysics Subcommittee, and SMD. The ExoPAG will take direction from APS, and report to APS.

Major reasons for proposing the Recommendation

Over 340 planets around other stars—exoplanets—have been found since the first discovery in 1989. Most exoplanets have masses greater than that of Jupiter. The Kepler mission, launched in 2009, is the first space mission designed to search for Earth-size exoplanets. A number of other advanced mission concepts have been conceived. Exoplanet exploration will be a major topic for the Astronomy & Astrophysics Decadal Survey. The Astrophysics Subcommittee (APS) and SMD need tactical input from the community on matters related to the implementation of exoplanet exploration missions going into or coming out of the decadal survey process. The APS and Science Committee recommend formation of an Exoplanet Exploration Program Analysis Group (ExoPAG), analogous to the existing Analysis Groups under the Planetary Science Subcommittee. The APS will provide oversight and evaluation of ExoPAG activities.

Consequences of no action on the proposed Recommendation

NASA and the APS will lack the means to bring the exoplanet science community together to conduct technical and scientific analyses required to inform new mission concepts and options.

NASA Advisory Council
Council Recommendation

Tracking Number: SC-09-04

Committee name: Science Committee

Chair: Dr. Jack Burns

Date of public deliberation: April 16, 2009

Date of transmission: April 29, 2009

Short title of the proposed Recommendation

Process for identifying non-science requirements and funding for Earth observations

Short description of proposed Recommendation

Recommend NASA work with OSTP and other agencies at the highest levels to define responsibilities and secure funding for Earth observations beyond those recommended by the NRC Decadal Survey to advance Earth System Science.

Major reasons for proposing the Recommendation

NASA's Earth observing satellites are the space-based component of the nation's Climate Change Research Program. Satellites provide the only means for obtaining global and near-synoptic observations. However, the requirements and expectations for Earth observing satellites placed on NASA far exceed the resources allocated. These requirements and expectations can be grouped in four categories. "Foundational" missions are those currently under development, and these are fully funded. "Decadal Survey" missions are those recommended by the National Research Council (NRC) for NASA for the next decade; NASA has initiated work on these, but with currently projected budget resources, less than half can be completed in the timeframe recommended by the NRC. "National Needs" missions are those not included in the Decadal Survey but meet needs recognized by the Congress; currently these are unfunded, though seed money for two of them was appropriated in Fiscal Year 2009. Finally, "Climate / Operational" missions are those that would meet requirements of other government agencies who have found data from past or present research satellites important; these missions are largely unfunded. Given the substantial mismatch between requirements and resources, a process is needed at the national level to define responsibilities and secure funding for these classes of Earth observing space missions. Current interagency coordination mechanisms are inadequate to resolve this issue. Action will require focused attention at the highest levels of the relevant agencies and OSTP.

Consequences of no action on the proposed Recommendation

Many of the nation's needs for space-based Earth observations will go unmet, and stakeholder expectations will remain unaligned with resource availability.

NASA Advisory Council
Council Recommendation

Tracking Number: SC-09-05

Committee names: Science, Exploration and Space Operations Committees

Chairs: Dr. Jack Burns, Gen James Abrahamson (Ret.), Col. Eileen Collins (Ret.)

Date of public deliberation: April 16, 2009

Date of transmission: April 29, 2009

Short title of the proposed Recommendation

Independent study of space communications - requirements, capabilities, and architecture

Short description of proposed Recommendation

Recommend NASA contract for an independent study of space communications needs for science, exploration, and space operations, including:

- Assessment of needs
- Assessment of new and emerging communications technologies
- End-to-end view of the communications system
- Identification of future capabilities that may not be available commercially
- Identification of factors including cost that should define an optimal mix of optical communications, radio arrays, and other techniques
- Consideration of international and interagency plans

The report resulting from this study should include findings and recommendations that will assist NASA in planning a communications architecture that will enable the successful conduct of missions planned or conceivable through 2030 as well as the national objectives outlined above. This study should result in recommendations that will assist NASA in development of more detailed, quantifiable requirements.

Major reasons for proposing the Recommendation

NASA's space communications infrastructure is aging, while the number of missions and data rates is increasing. NASA is already constrained by limits in total communications capability from some missions, including science and other vital NASA operational space missions. For the future, NASA is embarking on long-term planning for human and robotic exploration of the Moon and beyond as well as continued scientific exploration of the solar system and the universe. Both scientific data collection and safe mission operations will be highly dependent on more robust communications capability. NASA is already examining the architecture for improved space communications.

This planning would be usefully informed by an independent, external study of future space communications needs and capabilities. Any major upgrade to the nation's space

communications capability must endure for several decades and incorporate new and evolving technologies as well as security and growth capabilities as a national asset. It is therefore vital that the study include the views of other U.S. Government, academic and commercial potential customers and that these stakeholders should have a strong input to such a study.

Consequences of no action on the proposed Recommendation

If quantifiable requirements are not developed early, the future space communication and navigation system could be incomplete, inefficient, over budget, late in schedule, at risk for attack, at risk for failure, or expose future human and robotic space missions to safety and security problems.